

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Mikio IKENISHI et al.

Serial No.: 10/810,896

Filed: 03/29/2004

For: Glass substrate for information recording medium  
and Magnetic information recording medium to which the  
glass substrate is applied

DECLARATION

Honorable Commissioner of Patent and Trademarks  
Washington, D.C. 20231

I, Mikio IKENISHI, declare that I graduated from  
Japan Advanced Institute of Science and Technology in  
March, 1998 and that I joined HOYA CORPORATION in April, 1998  
and have been worked for researches and developments with  
regard to glass science.

I am the first-named inventor of the above  
identified patent application and am familiar with the  
subject matter of the present invention.

For making clear a difference between the glass of  
the present invention and each of two glasses, glass No. 36  
("glass I" hereinafter) and glass No. 37 ("glass II"  
hereinafter) in TABLE 3 of Yamamoto et al. U.S. PATENT  
6,577,472 cited in the examination of the present  
application ("Reference 1" hereinafter), I carried out the  
following duplicative experiments and measured each of the  
thus-obtained glasses for a Young's modulus and a density  
to determine a specific modulus (a value obtained by  
dividing a Young's modulus by a density).

## Experiments

Each of raw materials shown in the following Table A was weighed for obtaining compositions of the glasses I and II described in Reference 1, and they were fully mixed to prepare formulated batches. The formulated batches were respectively placed in platinum crucibles, melted under heat, refined and stirred to obtain homogeneous molten glasses. Table A shows heating time periods and heating temperatures. Each of the molten glasses was respectively cast into a pre-heated carbon mold and gradually cooled in an annealing furnace, to obtain duplicate glasses of the glasses I and II disclosed in Reference 1.

Table A

	Glass I	Glass II
Raw materials	SiO <sub>2</sub> , Na <sub>2</sub> CO <sub>3</sub> , H <sub>2</sub> BO <sub>3</sub> , Al <sub>2</sub> O <sub>3</sub> , Gd <sub>2</sub> O <sub>3</sub> , CoO	SiO <sub>2</sub> , Na <sub>2</sub> CO <sub>3</sub> , H <sub>2</sub> BO <sub>3</sub> , Al <sub>2</sub> O <sub>3</sub> , CaCO <sub>3</sub> , CoO
Heating temperature	1,600°C	1,600°C
Heating time preiod	4 hours	4 hours

### Measurement of Young's modulus

Each of the duplicate glasses was measured according to the method described in the present specification, paragraph [0066].

### Measurement of density

Each of the duplicate glasses was measured according to an Archimedean method.

## Experimental Results

The following Table B shows specific moduli of the glasses I and II calculated by dividing the Young's modulus by the density of each of the glasses I and II.

Table B

	Glass I	Glass II
Young's modulus [GPa]	72.27	72.60
Density [g/cm <sup>3</sup> ]	2.593	2.461
Specific modulus [ $\times 10^6$ N·m/kg]	27.87	29.50

## Observations

The specific moduli of the glass I and the glass II were smaller than  $30 \times 10^6$  N·m/kg which is the lowest limit of the specific modulus defined in the present invention. Since it can be considered that the glasses I and II have larger specific moduli among those glasses which are specifically described in Reference 1, it can be concluded that Reference 1 specifically discloses no substrate formed of a glass having a specific modulus of  $30 \times 10^6$  N·m/kg or greater.

The undersigned declarant declares that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonments, or both, under section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent

issuing thereon.

Dated this 23<sup>th</sup> day of March 2005

Mikio Ikenishi,

Mikio IKENISHI

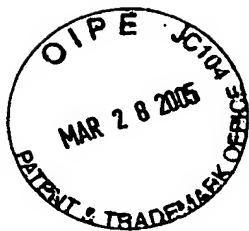


Table Ia  
Glass Compositions, expressed by mol%, of Examples 1 to 7  
in Yamamoto Reference

	1	2	3	4	5	6	7
Composition	mol%	mol%	mol%	mol%	mol%	mol%	mol%
SiO <sub>2</sub>	70.95	70.88	70.53	53.98	69.95	48.14	70.95
B <sub>2</sub> O <sub>3</sub>	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al <sub>2</sub> O <sub>3</sub>	0.52	0.29	0.52	0.61	0.30	0.56	0.52
B <sub>2</sub> O <sub>3</sub> /Al <sub>2</sub> O <sub>3</sub>	0	0	0	0	0	0	0
Li <sub>2</sub> O	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na <sub>2</sub> O	13.28	12.49	13.29	10.10	11.71	9.06	13.28
K <sub>2</sub> O	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MgO	5.98	4.43	5.99	4.51	3.00	4.12	5.98
CaO	8.39	7.43	8.40	6.36	6.47	5.69	8.39
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TiO <sub>2</sub>	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO <sub>2</sub>	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd <sub>2</sub> O <sub>3</sub>	0.49	0.49	0.49	0.52	0.50	0.53	0.49
Er <sub>2</sub> O <sub>3</sub>	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CoO	0.39	3.98	0.79	23.91	8.08	31.89	0.00
NiO	0.00	0.00	0.00	0.00	0.00	0.00	0.39
FeO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
SiO <sub>2</sub> +B <sub>2</sub> O <sub>3</sub> + Al <sub>2</sub> O <sub>3</sub> +R <sub>2</sub> O+R <sub>0</sub>	99.12	95.53	98.73	75.57	91.42	67.58	99.12
SiO <sub>2</sub> +B <sub>2</sub> O <sub>3</sub> + Al <sub>2</sub> O <sub>3</sub> +R <sub>2</sub> O	84.75	83.66	84.34	64.70	81.95	57.77	84.75

Table Ib  
Glass Compositions, expressed by mol%, of Examples 8 to 14  
in Yamamoto Reference

	8	9	10	11	12	13	14
Composition	mol%	mol%	mol%	mol%	mol%	mol%	mol%
SiO <sub>2</sub>	70.87	70.94	70.76	69.22	69.25	69.23	69.72
B <sub>2</sub> O <sub>3</sub>	0.00	0.00	0.00	4.36	3.52	5.27	4.43
Al <sub>2</sub> O <sub>3</sub>	0.29	0.52	0.29	0.60	0.60	0.60	0.60
B <sub>2</sub> O <sub>3</sub> /Al <sub>2</sub> O <sub>3</sub>	0	0	0	7.266667	5.866667	8.783333	7.383333
Li <sub>2</sub> O	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na <sub>2</sub> O	12.49	13.28	12.47	9.80	7.90	9.87	7.95
K <sub>2</sub> O	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MgO	4.43	5.98	4.43	7.54	7.59	6.07	6.12
CaO	7.43	8.39	7.42	7.58	6.55	7.63	6.59
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TiO <sub>2</sub>	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO <sub>2</sub>	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd <sub>2</sub> O <sub>3</sub>	0.49	0.49	0.49	0.50	0.51	0.51	0.00
Er <sub>2</sub> O <sub>3</sub>	0.00	0.00	0.00	0.00	0.00	0.00	0.48
CoO	0.00	0.00	0.00	0.41	4.09	0.82	4.11
NiO	3.99	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.00	0.41	4.14	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
SiO <sub>2</sub> +B <sub>2</sub> O <sub>3</sub> + Al <sub>2</sub> O <sub>3</sub> +R <sub>2</sub> O+R <sub>0</sub>	95.52	99.10	95.37	99.09	95.41	98.68	95.40
SiO <sub>2</sub> +B <sub>2</sub> O <sub>3</sub> + Al <sub>2</sub> O <sub>3</sub> +R <sub>2</sub> O	83.65	84.73	83.52	83.98	81.27	84.97	82.70

Table Ic  
Glass Compositions, expressed by mol%, of Examples 15 to 21  
in Yamamoto Reference

	15	16	17	18	19	20	21
Composition	mol%	mol%	mol%	mol%	mol%	mol%	mol%
SiO <sub>2</sub>	71.82	73.53	68.57	71.11	66.89	56.76	56.12
B <sub>2</sub> O <sub>3</sub>	2.82	2.89	3.43	0.00	0.00	12.11	12.21
Al <sub>2</sub> O <sub>3</sub>	0.64	0.66	0.59	0.29	4.69	9.59	9.67
B <sub>2</sub> O <sub>3</sub> /Al <sub>2</sub> O <sub>3</sub>	4.40625	4.378788	5.813559	0	0	1.262774	1.262668
Li <sub>2</sub> O	0.00	0.00	0.00	0.00	20.75	0.00	0.00
Na <sub>2</sub> O	6.33	5.40	9.63	12.53	2.72	16.44	16.89
K <sub>2</sub> O	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MgO	6.49	4.98	7.41	4.45	0.70	0.00	0.00
CaO	5.83	5.97	6.39	7.46	0.50	0.00	0.00
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TiO <sub>2</sub>	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO <sub>2</sub>	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd <sub>2</sub> O <sub>3</sub>	0.00	0.00	0.00	0.00	0.00	0.56	0.56
Er <sub>2</sub> O <sub>3</sub>	1.71	2.10	0.00	0.00	0.00	0.00	0.00
CoO	4.37	4.47	3.99	0.00	3.75	4.54	4.54
NiO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.00	0.00	0.00	4.16	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
SiO <sub>2</sub> +B <sub>2</sub> O <sub>3</sub> + Al <sub>2</sub> O <sub>3</sub> +R <sub>2</sub> O+R <sub>0</sub>	93.93	93.43	96.01	95.84	96.25	94.90	94.90
SiO <sub>2</sub> +B <sub>2</sub> O <sub>3</sub> + Al <sub>2</sub> O <sub>3</sub> +R <sub>2</sub> O	81.61	82.48	82.22	83.93	95.05	94.90	94.90

Table Id  
Glass Compositions, expressed by mol%, of Examples 22 to 28  
in Yamamoto Reference

	22	23	24	25	26	27	28
Composition	mol%	mol%	mol%	mol%	mol%	mol%	mol%
SiO <sub>2</sub>	83.02	84.70	65.72	67.31	64.30	64.18	70.35
B <sub>2</sub> O <sub>3</sub>	3.73	3.37	9.81	9.40	13.37	14.48	3.40
Al <sub>2</sub> O <sub>3</sub>	1.24	1.37	8.01	7.72	0.63	0.38	2.26
B <sub>2</sub> O <sub>3</sub> /Al <sub>2</sub> O <sub>3</sub>	3.008065	2.459854	1.224719	1.217617	21.22222	38.10526	1.504425
Li <sub>2</sub> O	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na <sub>2</sub> O	7.25	5.82	11.44	10.55	16.88	16.15	19.19
K <sub>2</sub> O	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TiO <sub>2</sub>	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO <sub>2</sub>	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd <sub>2</sub> O <sub>3</sub>	0.52	0.52	0.55	0.55	0.53	0.53	0.53
CoO	4.23	4.23	4.47	4.46	4.29	4.28	4.27
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
SiO <sub>2</sub> +B <sub>2</sub> O <sub>3</sub> + Al <sub>2</sub> O <sub>3</sub> +R <sub>2</sub> O+R <sub>0</sub>	95.25	95.25	94.98	94.99	95.18	95.18	95.20
SiO <sub>2</sub> +B <sub>2</sub> O <sub>3</sub> + Al <sub>2</sub> O <sub>3</sub> +R <sub>2</sub> O	95.25	95.25	94.98	94.99	95.18	95.18	95.20



Table Ie  
Glass Compositions, expressed by mol%, of Examples 29 to 35  
in Yamamoto Reference

	29	30	31	32	33	34	35
Composition	mol%	mol%	mol%	mol%	mol%	mol%	mol%
SiO <sub>2</sub>	70.15	64.87	65.40	79.95	80.09	66.21	66.24
B <sub>2</sub> O <sub>3</sub>	4.14	6.04	6.33	4.62	4.99	13.62	13.70
Al <sub>2</sub> O <sub>3</sub>	2.13	3.17	3.36	3.15	3.34	0.38	0.19
B <sub>2</sub> O <sub>3</sub> /Al <sub>2</sub> O <sub>3</sub>	1.943662	1.905363	1.883929	1.466667	1.494012	35.84211	72.10526
Li <sub>2</sub> O	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na <sub>2</sub> O	18.78	21.07	20.05	7.46	6.75	14.98	15.07
K <sub>2</sub> O	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TiO <sub>2</sub>	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO <sub>2</sub>	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd <sub>2</sub> O <sub>3</sub>	0.53	0.54	0.54	0.53	0.53	0.53	0.53
CoO	4.27	4.32	4.32	4.29	4.30	4.28	4.27
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
SiO <sub>2</sub> +B <sub>2</sub> O <sub>3</sub> + Al <sub>2</sub> O <sub>3</sub> +R <sub>2</sub> O+R <sub>0</sub>	95.20	95.15	95.14	95.18	95.17	95.19	95.20
SiO <sub>2</sub> +B <sub>2</sub> O <sub>3</sub> + Al <sub>2</sub> O <sub>3</sub> +R <sub>2</sub> O	95.20	95.15	95.14	95.18	95.17	95.19	95.20

Table If  
Glass Compositions, expressed by mol%, of Examples 36 to 41  
in Yamamoto Reference

	36	37	38	39	40	41
Composition	mol%	mol%	mol%	mol%	mol%	mol%
SiO <sub>2</sub>	65.48	69.96	70.30	71.12	71.45	71.79
B <sub>2</sub> O <sub>3</sub>	6.41	8.24	8.12	7.97	7.84	7.71
Al <sub>2</sub> O <sub>3</sub>	3.04	5.00	4.91	4.80	4.71	4.61
B <sub>2</sub> O <sub>3</sub> /Al <sub>2</sub> O <sub>3</sub>	2.108553	1.648	1.653768	1.660417	1.664544	1.672451
Li <sub>2</sub> O	0.00	0.00	0.00	0.00	0.00	0.00
Na <sub>2</sub> O	20.22	10.28	10.15	9.47	9.12	8.77
K <sub>2</sub> O	0.00	0.00	0.00	0.00	0.00	0.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00
CaO	0.00	2.27	2.06	1.74	1.76	1.77
SrO	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00
ZnO	0.00	0.00	0.00	0.00	0.00	0.00
TiO <sub>2</sub>	0.00	0.00	0.00	0.00	0.00	0.00
ZrO <sub>2</sub>	0.00	0.00	0.00	0.00	0.00	0.00
Gd <sub>2</sub> O <sub>3</sub>	0.54	0.00	0.18	0.54	0.73	0.92
CoO	4.31	4.25	4.29	4.36	4.39	4.42
Total	100.00	100.00	100.00	100.00	100.00	100.00
SiO <sub>2</sub> +B <sub>2</sub> O <sub>3</sub> + Al <sub>2</sub> O <sub>3</sub> +R <sub>2</sub> O+R <sub>0</sub>	95.15	95.54	95.10	94.88	94.66	95.75
SiO <sub>2</sub> +B <sub>2</sub> O <sub>3</sub> + Al <sub>2</sub> O <sub>3</sub> +R <sub>2</sub> O	95.15	93.48	93.36	93.12	92.89	93.48

Table Ig  
Glass Compositions, expressed by mol%, of Examples 42 to 44  
in Yamamoto Reference

	42	43	44
Composition	mol%	mol%	mol%
SiO <sub>2</sub>	73.04	73.17	73.54
B <sub>2</sub> O <sub>3</sub>	7.42	6.73	6.59
Al <sub>2</sub> O <sub>3</sub>	4.40	3.92	3.82
B <sub>2</sub> O <sub>3</sub> /Al <sub>2</sub> O <sub>3</sub>	1.686364	1.716837	1.725131
Li <sub>2</sub> O	0.00	0.00	0.00
Na <sub>2</sub> O	7.89	8.45	8.07
K <sub>2</sub> O	0.00	0.00	0.00
MgO	0.00	0.00	0.00
CaO	1.21	1.23	1.24
SrO	0.00	0.00	0.00
BaO	0.00	0.00	0.00
ZnO	0.00	0.00	0.00
TiO <sub>2</sub>	0.00	0.00	0.00
ZrO <sub>2</sub>	0.00	0.00	0.00
Gd <sub>2</sub> O <sub>3</sub>	1.50	1.90	2.11
CoO	4.54	4.60	4.64
Total	100.00	100.00	100.00
SiO <sub>2</sub> +B <sub>2</sub> O <sub>3</sub> + Al <sub>2</sub> O <sub>3</sub> +R <sub>2</sub> O+R <sub>0</sub>	93.96	93.50	93.25
SiO <sub>2</sub> +B <sub>2</sub> O <sub>3</sub> + Al <sub>2</sub> O <sub>3</sub> +R <sub>2</sub> O	92.75	92.27	92.01

Table II

Physical properties of glasses in Examples 39 to 80 of the present specification and in Examples 36 and 37 of Yamamoto reference.

Example	39	40	41	42	43	44	46	56
Density $[g/cm^3]$	2.470	2.465	2.460	2.464	2.458	2.446	2.449	2.382
Young's modulus $[GPa]$	82.37	81.16	79.50	83.61	82.10	79.04	79.92	72.62
Specific modulus $[\times 10^6 N \cdot m/kg]$	33.35	32.92	32.32	33.93	33.40	32.31	32.63	30.49
Example	57	58	59	60	61	62	64	65
Density $[g/cm^3]$	2.359	2.492	2.456	2.444	2.415	2.420	2.428	2.428
Young's modulus $[GPa]$	71.84	81.35	83.13	80.45	77.88	80.13	78.75	79.23
Specific modulus $[\times 10^6 N \cdot m/kg]$	30.45	32.64	33.85	32.92	32.25	33.11	32.43	32.63
Example	66	67	68	69	70	71	72	73
Density $[g/cm^3]$	2.480	2.422	2.427	2.450	2.448	2.431	2.431	2.421
Young's modulus $[GPa]$	81.53	80.56	81.00	83.00	80.96	81.57	79.91	80.67
Specific modulus $[\times 10^6 N \cdot m/kg]$	32.88	33.26	33.37	33.88	33.07	33.55	32.87	33.32
Example	74	75	76	77	78	79	80	minimum value
Density $[g/cm^3]$	2.453	2.452	2.420	2.429	2.440	2.431	2.434	
Young's modulus $[GPa]$	77.98	77.81	78.83	80.62	82.07	82.00	80.81	71.84
Specific modulus $[\times 10^6 N \cdot m/kg]$	31.79	31.73	32.57	33.19	33.64	33.73	33.20	30.45
Yamamoto Reference	Example No. 36				Example No. 37			
Density $[g/cm^3]$	2.593				2.461			
Young's modulus $[GPa]$	72.27				72.60			
Specific modulus $[\times 10^6 N \cdot m/kg]$	27.87				29.50			